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Jawaharlal Nehru

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IS 6133-1 (1971): Piezo-electric Filters for Use in Telecommunication and Measuring Equipment, Part I: General Requirements and Tests [LITD 5: Semiconductor and Other Electronic Components and Devices]

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Bhartṛhari—Nītiśatakam

“Knowledge is such a treasure which cannot be stolen”



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Indian Standard

SPECIFICATION FOR PIEZO-ELECTRIC
FILTERS FOR USE IN TELECOMMUNICATION
AND MEASURING EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 1

Indian Standard

**SPECIFICATION FOR PIEZO-ELECTRIC
FILTERS FOR USE IN TELECOMMUNICATION
AND MEASURING EQUIPMENT**

PART I GENERAL REQUIREMENTS AND TESTS

Piezo-Electric and Magnetic Materials Sectional Committee, ETDC 41

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Wg CDR S. RAO

SHRI V. B. GUPTA (*Alternate*)

RESEARCH ENGINEER

SHRI A. S. SHARMA

SHRI V. V. KELKAR (*Alternate*)

SHRI Y. S. VENKATESWARAN,

Director (Elec tech)

Representing

National Physical Laboratory, New Delhi

Directorate General of Research & Development
(DGRD) (Ministry of Defence)

Indian Telephone Industries Limited, Bangalore
Ministry of Defence (DGI)

Directorate General of Posts & Telegraphs (Tele-
communication Research Centre)

National Physical Laboratory, New Delhi

National Test House, Calcutta

Semiconductors Limited, Poona

Central Electronics Engineering Research Institute,
Pilani

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Bharat Electronics Limited, Bangalore

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The Radio Electronics & Television Manufacturers'
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Secretary

SHRI S. MUKHOPADHYAY

Assistant Director (Elec tech), ISI

Director General, ISI (*Ex-officio Member*)

INDIAN STANDARDS INSTITUTION

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 1

AMENDMENT NO. 2 AUGUST 1978
TO
**IS : 6133 (Part I) - 1971 SPECIFICATION FOR
PIEZOELECTRIC FILTERS FOR USE IN
TELECOMMUNICATION AND
MEASURING EQUIPMENT**

PART I GENERAL REQUIREMENTS AND TESTS

Alterations

(*Page 3, clause 4.1, lines 1 and 2*) — Substitute 'IS : 8271-1976†' for 'IS : 2916 (Part I)-1969†'.

(*Page 3, foot-note with '†' mark*) — Substitute the following for the existing foot-note:

'†Specification for general requirements and tests for quartz crystal units used for frequency control and selection.'

(LTDC 12)

Printed at Simco Printing Press, Delhi, India

AMENDMENT NO. 1

JULY 1977

TO

IS : 6133 (Part I)-1971 **SPECIFICATION FOR**
PIEZO-ELECTRIC FILTERS FOR USE IN
TELECOMMUNICATION AND MEASURING
EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

Alterations

(Page 4, clause 6) — Substitute the following matter for the existing clause:

‘6. MARKING

6.1 Each piezo-electric filter unit shall have the following information clearly and indelibly marked on it:

- a) Reference frequency,
- b) Type designation,
- c) Characteristics, and
- d) Ultimate attenuation.

6.1.1 In addition to **6.1**, the following information, necessary to obtain a complete description of the filter, may be marked either on the piezo-electric filter unit or on the carton containing the units:

- a) Diagram of pin connections,
- b) Manufacturer's name or trade-mark,
- c) Batch number or serial number, and
- d) Country of origin.

6.2 A suitable code for marking the information contained in **6.1** and **6.1.1** on the piezo-electric filter units to provide complete definition of the unit is given in Appendix B.

6.3 The piezo-electric filter unit or its carton may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

(Page 4, clause 7.1.1, line 4) — Substitute 'piezo-electric filters' for 'crystal filters'.

Addenda

(Page 6, clause 7.3.1.3, Note 2) — Add the following new Note after Note 2:

'NOTE 3 — Should the product be measured and test conditions be such that the voltage measured across the load R_L be greater than the maximum voltage which can be set across R_O , it may be necessary to employ an impedance matching transformer as a part of the measuring circuit to overcome this condition.'

(Page 15, Appendix A) — Add the following new Appendix after Appendix A:

APPENDIX B (Clause 6.2)

CODE FOR MARKING ON CRYSTAL FILTER UNITS

B-0. GENERAL

B-0.1 The following shall be marked in the order indicated preferably one below the other (see B-5):

- a) Reference frequency,
- b) Type designation,
- c) Characteristics, and
- d) Ultimate attenuation.

B-1. REFERENCE FREQUENCY

B-1.1 Reference frequency shall be marked in MHz or kHz as is convenient.

Example — 10.7 MHz, 60 kHz, etc.

NOTE — In case of band pass filter the reference frequency will be the centre frequency for most cases except for single side band filters. In the single side band filters, the carrier frequency is used as reference.

B-2. TYPE DESIGNATION

B-2.1 The type designation of the unit shall be indicated by a two letter code for the outlines (see Table 1 of IS : 4570-1968*) followed by a two digit number which refers to the relevant detail specification of the filter unit. The two items are separated by a hyphen.

Example — AA-05

*Specification for crystal holders.

B-3. CHARACTERISTICS

B-3.1 Characteristics shall be represented by code described below.

B-3.1.1 A single or two letter code shall be used to indicate the type of operation such as, Band pass, High pass, Low pass, Band stop, Comb, etc. These various types of operations shall be modified as below:

BP — Band pass

HP — High pass

LP — Low pass

BS — Band stop

C — Comb

B-3.1.2 The single or two letter code will be followed by a digit such as '3' or '6' to indicate the attenuation level at which the bandwidth is specified.

B-3.1.3 This digit will be followed by a letter to indicate the unit of the bandwidth. The letters will be:

M — standing for MHz

K — standing for kHz

E — standing for Hz

B-3.1.4 This letter will be followed by a number which indicates the bandwidth in kHz at the attenuation level (see **B-3.1.2**). This number may be of a single digit, two digits or two digits with a decimal.

Example — 6, 18 and 2.7.

B-3.1.5 Examples of code for characteristics:

- a) BP 6 K 36 — Band pass filter with 36 kHz bandwidth at 6 dB attenuation.
- b) HP 3 K 2.7 — High pass filter with 2.7 kHz bandwidth at 3 dB attenuation.
- c) LP 3 K 2.7 — Low pass filter with 2.7 kHz bandwidth at 3 dB attenuation.

B-4. ULTIMATE ATTENUATION

B-4.1 Ultimate attenuation shall be indicated by a two or three digit number as suitable.

Example — 80 or 100, where 80 means 80 dB and 100 means 100 dB.

B-5. COMPLETE MARKING CODE

B-5.1 The entire marking code will appear thus:

10.7 MHz

AA-05

BP6K36

80

The 4 lines may be marked in 4 lines one below the other if space permits or on suitable locations of the filter can, in case space does not permit.

B-6. ADDITIONAL MARKINGS

B-6.1 Diagram of Pin Connections — The diagram of pin connections shall be provided using appropriate graphical symbols.

B-6.2 Manufacturer's Name or Trade-Mark — The manufacturer shall suitably indicate the manufacturer's name or trade-mark.

B-6.3 Batch Number or Serial Number — The manufacturer shall suitably indicate the batch number or the serial number of the piezo-electric filter unit.

(LTDC 12)

Indian Standard

SPECIFICATION FOR PIEZO-ELECTRIC FILTERS FOR USE IN TELECOMMUNICATION AND MEASURING EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 31 May 1971, after the draft finalized by the Piezo-Electric and Magnetic Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard (Part I) deals with general requirements and methods of test applicable to all types of piezo-electric filters for use in telecommunication and measuring equipment.

0.2.1 The applicability of the tests to each type of piezo-electric filters and the specific requirements for each test will be stated in the relevant specification for that type; should, however, any deviation exist between the provisions of this standard and those of the relevant individual specification, the provision of the latter shall prevail.

0.3 The object of this standard is to specify uniform requirements and conditions for assessing the electrical, mechanical and climatic properties of piezo-electric filters, to describe test methods and to give recommendations for standard values.

0.4 The standard requires reference to IS : 589 - 1961* so far as the details of the climatic and mechanical testing procedures are concerned, only the relevant degrees of severities and the performance requirements have been specified in this standard.

0.5 In preparing this standard assistance has been derived from the following documents:

IEC Doc : 49 (Central Office) 49 Draft-Recommendation for piezo-electric filters for use in telecommunication and measuring equipment. Section One: General information and standard values. International Electrotechnical Commission.

IEC Doc : 49 (Central Office) 50 Draft-Recommendation for piezo-electric filters for use in telecommunication and measuring equipment. Section Two: Test conditions. International Electrotechnical Commission.

*Basic climatic and mechanical durability tests for electronic components (revised).

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part I) deals with the general requirements and methods of test relating to piezo-electric filters for use in telecommunication and measuring equipment.

2. TERMINOLOGY

2.0 For the purpose of this standard, the terms and definitions given in IS : 1885 (Part...)† shall apply in addition to those given below.

2.1 Type — A type comprises of piezo-electric filters having similar design features, manufactured by the same techniques and falling within the manufacturers' usual range of ratings for the device.

2.2 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to check the general qualities and design of a given type of piezo-electric filters.

2.3 Acceptance Tests — Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.

2.3.1 Lot — All piezo-electric filters of the same type, category and rating, manufactured by the same factory, during the same period, using the same process and materials.

2.4 Routine Tests — Tests carried out on each piezo-electric filter to check the requirements which are likely to vary during production.

3. STANDARDS VALUES AND TOLERANCES — Under consideration.

4. STANDARD OPERATING TEMPERATURE RANGE

4.1 The operating temperature range shall be as given in 5.1 of IS : 2916 (Part I) - 1969‡.

5. WORKMANSHIP

5.1 The filters shall be manufactured in accordance with good engineering practice.

*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part... Piezo-electric filters (*under preparation*).

‡Quartz crystal units used in oscillators : Part I General requirements and tests.

5.2 Unless otherwise specified, the filters with metal holders shall have earthing facilities for the holders.

6. MARKING

6.1 Each filter crystal unit shall have the following information clearly and indelibly marked on it :

- a) Manufacturer's type designation and/or code number,
- b) Reference frequency, and
- c) Country of origin.

NOTE — In case of band pass filter the reference frequency will be the centre frequency for most cases except for single side band filters. In the single side band filters the carrier frequency is used as reference.

6.2 In addition to **6.1** above, the following information, necessary to obtain a complete definition of filter, may be marked either on the filter crystal unit or on the carton containing the units:

- a) Pass/stop band-width,
- b) Diagram of pin connections, and
- c) Batch number or serial number.

6.2.1 The filter crystal unit or its carton may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act, and the Rules and Regulations made thereunder. Presence of this mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard, under a well-defined system of inspection, testing and quality control during production. This system, which is devised and supervised by ISI and operated by the producer, has the further safeguard that the products as actually marketed are continuously checked by ISI for conformity to the standard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. TESTS

7.1 Classification of Tests

7.1.1 Type Tests — The procedure for type approval shall be as given in IS : 2612 - 1965*. The minimum number of samples for type tests shall be 24 of each type. The sequence of type tests shall be as given in Appendix A. The crystal filters which have been subjected to these type tests shall not be used in equipment or returned to bulk supply.

NOTE — For special type of filters, the number of samples should be agreed to between the manufacturer and the customer.

*Recommendations for type approval and sampling procedures for electronic components.

7.1.2 Acceptance Test — The acceptance test shall be carried out on a limited number of samples which have passed the routine tests. The samples shall be selected in accordance with Appendix B of IS : 2612 - 1965*. Two groups of samples one for non-destructive tests (Group A) and the other for destructive tests (Group B) shall be selected and each group shall be subjected to the following tests in the order given below:

Group A (Non-destructive)

Dimension (**7.4.2**)

Electrical tests (**7.3**)

Group B (Destructive)

Bump (**7.4.6**)

Vibration (**7.4.5**)

Robustness of terminations (**7.4.4**)

Sealing (**7.4.7**)

Climatic sequence (**7.5.1**)

7.1.3 Routine Tests — The following tests shall constitute routine tests and shall be carried out on each and every filter crystal unit:

- General examination (**7.4.1**), and
- Electrical tests (**7.3**).

7.2 General Conditions for Tests

7.2.1 Atmospheric Conditions for Testing — Unless otherwise specified, all the tests shall be carried out under standard atmospheric conditions specified in IS : 589 - 1961†.

7.2.2 Preconditioning — Before measurements are made the filter crystal units shall be stored at the measuring temperature for a time sufficient to allow the entire unit to reach that temperature. The recovery period called for after conditioning is adequate for the purpose.

7.2.3 Correction to be Applied — When the measurements are made at a temperature other than the standard temperature the results shall be corrected, where necessary, to the specified temperature. Ambient temperature during the measurement shall be stated in the test report.

7.2.4 Precautions — During measurements the filter shall not be exposed to conditions likely to invalidate the measurement.

7.2.5 Selection of Samples — The samples for testing shall be so selected as to be representatives of each type, category and rating.

*Recommendation for type approval and sampling procedures for electronic components.

†Basic climatic and mechanical durability tests for electronic components (*revised*).

7.3 Electrical Tests

7.3.1 Attenuation Measurement

7.3.1.1 General conditions — The filters shall be mounted in a test jig, in which the stray coupling between input and output terminals is kept at a minimum by proper shielding and earthing.

7.3.1.2 Principle of measurement — The filter with the specified terminal impedances is substituted by a calibrated attenuator which is adjusted to an equal output voltage. The transducer attenuation and the insertion attenuation may be calculated from the reading of the attenuator.

7.3.1.3 Measuring circuit — The measuring circuit shall be as shown in Fig. 1.

NOTE 1 — Commercially available filter test equipment may be used provided that correlation has been achieved.

NOTE 2 — The temperature of the test jig during the measurement shall be within the temperature range of the filter to be tested.

a) *Signal generator* — Within a range of ± 10 percent of the frequency at which the signal generator is adjusted, the total output apart from that at the adjusted frequency shall be at least 80 dB below the main output. When measured at the detection element, the output at any harmonic of the frequency for which the signal generator is adjusted shall be at least 60 dB below the output at the fundamental frequency. Harmonic suppression filters may be used if necessary. The output level shall preferably be automatically controlled.

b) *Selective voltmeter* — The sensitivity shall be such that, in conjunction with the signal generator used, it is possible to detect:

- 1) a change of 0.05 dB in input level or 10 percent of the minimum attenuation to be measured.
- 2) an output level μ_o corresponding with an adjustment of the attenuation equal to $A_{Max} + 10$ dB, where A_{Max} is the highest value of attenuation requirement in the stop band of the filter.

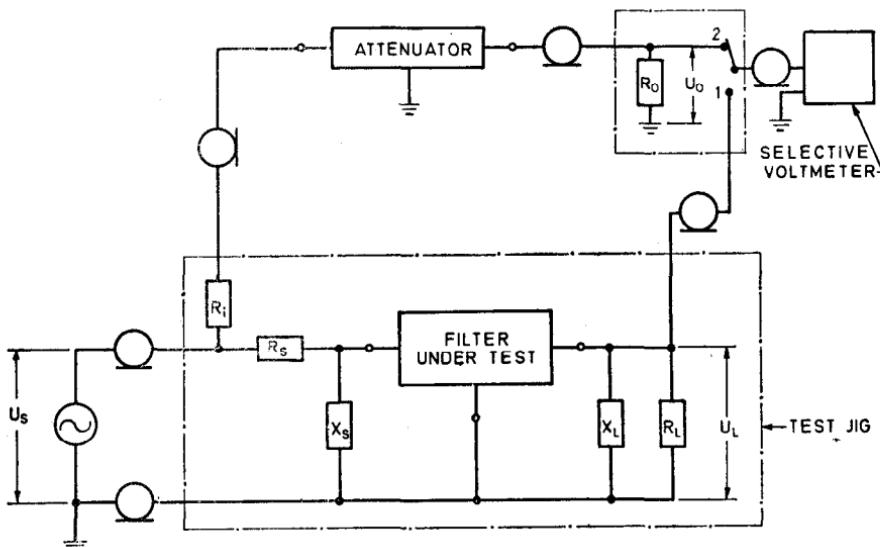
The absolute value of the input impedance shall be not less than 100 R_L or 100 R_o , whichever is the greater.

c) *Filter test jig* — Filters are often specified with termination impedances which include a reactive element in order to accommodate stray circuit reactances associated with the specific filter application. The reactances are usually shunt capacitances associated with stray capacitance.

In order to avoid complicating the transducer attenuation expression, it is convenient to assume resistive terminations in the test circuit by associating the reactive part of the required termination with the filter. For the narrow bandwidths of most filters, the resulting error is negligible.

The test jig shall be such that it satisfies the following test:

- 1) connects a well-shielded resistor equal to R_s to the plugs designed to contact the input terminals of the filter under test,
- 2) connects a well-shielded resistor equal to R_L to the plugs designed to contact the output terminals of the filter under test,
- 3) disconnects X_L and X_s , and
- 4) measures the transducer attenuation of the jig which shall not be less than $A_{Max} + 10$ dB, where A_{Max} is the highest value of attenuation requirement in the stop band of the filter.



U_L = voltage across the load

U_s = signal generator voltage

U_o = voltage across R_o (output voltage)

R_t } = terminating impedance of attenuator ($R_t = R_o$)

R_L } = resistive portion of the terminating admittance

X_L } = reactive portion of the terminating admittance

X_s } = reactive portion of the terminating admittance

FIG. 1 CIRCUIT FOR THE MEASUREMENT OF ATTENUATION

7.3.1.4 Method of measurement — Adjust the resistances R_L and R_s and the reactances X_L and X_s to the values specified in the relevant specification,

Adjust the output of the signal generator to a level lower than the maximum input level of the filter under test and adjust the frequency to one of the values specified in the relevant specification.

Set the switch in position 1 and measure the output voltage U_L . Adjust the attenuator to give the same voltmeter reading (switch in position 2).

7.3.1.5 Calculate the transducer attenuation and the insertion attenuation —
These can be calculated from the following formula:

$$a_t = a_r + 10 \log_{10} \frac{R_L}{R_S}$$

$$a_t = a_r - 20 \log_{10} \frac{R_S + R_L}{2 R_L}$$

where

a_t = transducer attenuation in decibels,

a_r = attenuator reading in decibels, and

a_i = insertion attenuation in decibels.

NOTE — For $R_S = R_L$, $a_t = a_i$.

7.3.2 Phase Characteristic Measurement

7.3.2.1 General conditions — The filter shall be mounted in a test jig, in which the stray coupling between input and output terminals is kept at a minimum by proper shielding and earthing.

7.3.2.2 Principle of measurement — The phase between the source voltage and the output voltage is measured. This phase angle is equal to the insertion phase as well as to the transducer phase.

7.3.2.3 Measuring circuit — The measuring circuit shall be as given in Fig. 2.

NOTE 1 — Commercially available filter test equipment may be used as well provided that correlation has been achieved.

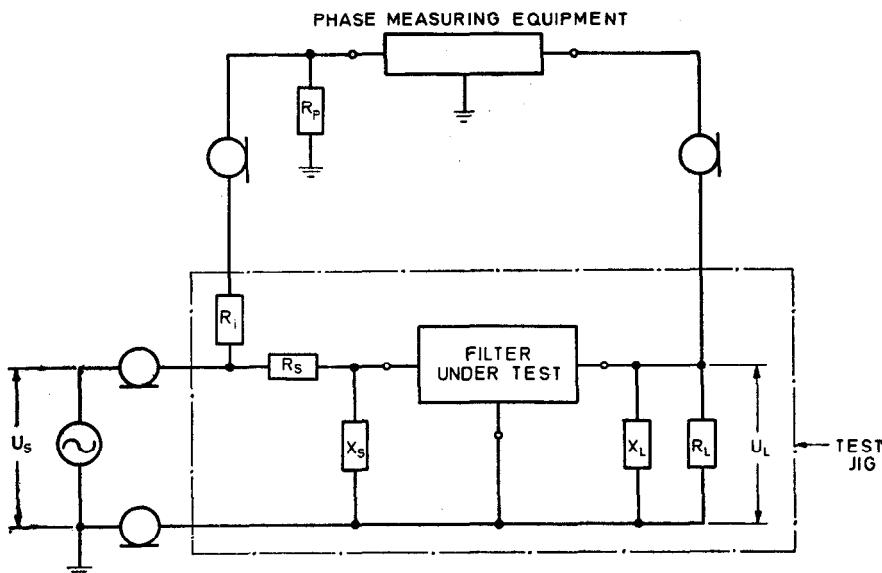
NOTE 2 — The temperature of the test jig during the measurements shall be within the temperature range of the filter to be tested.

a) *Signal generator* — The generator as prescribed in 7.3.1.3 may be used.

b) *Phase characteristic measuring equipment* — The absolute value of the input impedance shall be not less than $100 R_L$.

c) *Filter test jig* — The test jig as prescribed in 7.3.1.3 may be used.

7.3.2.4 Method of measurement and calculation — Adjust the resistances R_S and R_L and the reactances X_L and X_S to the values specified in the relevant specification. Replace the filter by a straight connection



R_p = terminating impedance

U_L = voltage across the load

U_s = signal generator voltage

R_t = terminating impedance of an attenuator

R_L } = resistive portion of the terminating admittance
 R_s } = resistive portion of the terminating admittance

X_L } = reactive portion of the terminating admittance
 X_s } = reactive portion of the terminating admittance

FIG. 2 CIRCUIT FOR THE MEASUREMENT OF PHASE CHARACTERISTICS

between input and output plug and note the reading of the phase meter. Insert the filter in the test jig and note the phase meter again. The insertion phase is the difference between these two readings.

7.3.3 Measurement of Transducer Attenuation and Phase Characteristics at Standard Atmospheric Conditions

7.3.3.1 The filter shall be inserted in the test circuit of 7.3.1.3 and the attenuation shall be measured over the specified frequency range at the rated level of drive.

7.3.3.2 The filter shall then be inserted in the test circuit of 7.3.2.3, and the phase characteristic shall be measured over the specified frequency range at the rated level of drive.

7.3.3.3 The attenuation and the phase characteristic shall be within the limits stated in the relevant specification.

7.3.4 Measurement of Transducer Attenuation and Phase Characteristics at Nominal Load Impedances

7.3.4.1 The filter shall be inserted in the test circuit of **7.3.1.3** with the terminating load impedances adjusted to the nominal values as given in the relevant specification.

7.3.4.2 The filter shall then be inserted in the test circuit of **7.3.2.3** with the terminating load impedances adjusted to the nominal values as given in the relevant specification.

7.3.4.3 The attenuation and the phase characteristic shall be within the limits stated in the relevant specification.

7.3.5 Measurement of Transducer Attenuation and Phase Characteristics at Minimum and Maximum Load Impedances

7.3.5.1 The filter shall be inserted in the test circuit of **7.3.1.3** with the resistive and reactive components of the terminating impedances adjusted successively to its minimum and maximum impedance levels as given in the relevant specification.

7.3.5.2 The filter shall then be inserted in the test circuit of **7.3.2.3** with the resistive and reactive components of the temperating impedances adjusted successively to its minimum and maximum impedance levels as given in the relevant specification.

7.3.5.3 The attenuation and the phase characteristic shall be within the limits stated in the relevant specification.

7.3.6 Measurement of Transducer Attenuation and Phase Characteristics as a Function of Temperature

7.3.6.1 The filter shall be inserted in the test circuit of **7.3.1.3** and the attenuation measured at the minimum and maximum temperatures of the specified temperature range at the rated level of drive and with nominal load impedance.

7.3.6.2 The filter shall then be inserted in the test circuit of **7.3.2.3** and the phase characteristic measured at the minimum and maximum temperatures of the specified temperature range at the rated level of drive and with nominal load impedance.

7.3.6.3 The attenuation and the phase characteristic shall be within the limits stated in the relevant specification.

7.3.7 Insulation Resistance

7.3.7.1 The insulation resistance shall be measured with a dc voltage as specified in the relevant specification applied between the terminations connected together and the metal parts of the case,

7.3.7.2 The insulation resistance shall be not less than the value specified in the relevant specification.

7.3.8 Voltage Proof (High Voltage)

7.3.8.1 An alternating voltage of a specified value shall be applied consecutively for a period of 5 seconds between the terminations connected together and the metal parts of the case.

7.3.8.2 The filter shall withstand the test without evidence of arcing, flashover, breakdown of insulation, or damage.

7.4 Mechanical Tests

7.4.1 General Examination — The filter shall be visually examined; there shall be no mechanical damage; and the marking shall be in accordance with 6.

7.4.2 Dimension — The dimensions shall be checked and they shall comply with the values specified in the relevant specification.

7.4.3 Soldering (Where Applicable) — This test shall be carried out in accordance with **7.18** of IS : 589-1961*, to determine the ability of the termination to wet easily and to check that the filter is not damaged by the soldering process. The method of test, that is Method 1 or Method 2, size of the soldering bit in case of Method 2 and the period of recovery shall be as specified in the relevant specification.

7.4.4 Robustness of Terminations

7.4.4.1 Tensile test — This test shall be carried out in accordance with **7.19.1** of IS : 589 - 1961* with a force as specified in the relevant specification. The load being applied along its axis for a period of 30 seconds. After the test there shall be no visible damage to the filter.

7.4.4.2 Bending test on wire and tag terminations — This test shall be carried out in accordance with **7.19.2** of IS : 589-1961*. The load required and the number of bends for wire and tag terminations shall be specified in the relevant specification. There shall be no visible damage to the filter after the test.

7.4.4.3 Bending test on pin terminations — The body of the unit shall be clamped and the pins loaded in turn, consecutively in opposite directions perpendicular to the pin axis with the force as specified in the relevant specification, for a period of 10 seconds in each direction. The force shall be applied as near to the free end of the pin as possible and in no case more than one-fourth of the pin length down from the free end. The force shall be applied gradually. After the test, there shall be no visible damage to the filter.

*Basic climatic and mechanical durability tests for electronic components (revised).

7.4.5 *Vibration*

7.4.5.1 The filter shall be subjected to the vibration test as given in 7.6 of IS : 589 - 1961*, using the specified degree of severity.

7.4.5.2 Unless otherwise specified the filters are rigidly mounted such that:

- a) one-third of the units shall have the direction of vibration parallel to the pin length,
- b) one-third of the units shall have the direction of vibration perpendicular to the largest surface, and
- c) one-third of the units shall have the direction of vibration perpendicular to the pin length and parallel to the largest surface.

7.4.5.3 After the vibration conditioning, the filters shall be visually examined. There shall be no visible damage.

7.4.5.4 The transducer attenuation and phase characteristics at standard atmospheric conditions and insulation resistance shall be measured. The change in the values shall not exceed the specified limits. The insulation resistance shall be as specified in 7.3.7 unless otherwise stated in the relevant specification.

7.4.5.5 If this test is included in the relevant specification, the degree of severity of the test shall be specified.

7.4.6 *Bump*

7.4.6.1 The filter shall be subjected to the bump test in accordance with 7.5 of IS : 589 - 1961*, using the specified degree of severity.

7.4.6.2 The filter shall then be visually examined. There shall be no visible damage.

7.4.6.3 The transducer attenuation and phase characteristics at standard atmospheric conditions shall then be measured. The change of value shall not exceed the specified limits.

7.4.6.4 If this test is included in the relevant specification, the degree of severity shall be specified.

7.4.7 Sealing — Under consideration.

7.5 **Climatic Tests**

7.5.1 *Climatic Sequence*

7.5.1.1 Dry heat — The filters shall be subjected to the test in accordance with 7.2 of IS : 589 - 1961* at the upper temperature of the operating temperature range.

After recovery the unit shall be visually examined. There shall be no visible damage.

*Basic climatic and mechanical durability tests for electronic components (revised).

If this test is included, the relevant specification shall specify the following:

- a) The duration of the test when deviating from the standard duration, and
- b) The recovery conditions when deviating from the standard recovery conditions.

7.5.1.2 Damp heat (accelerated) first cycle — The filters shall be subjected to the test in accordance with 7.4 of IS : 589-1961* for one cycle.

After recovery the unit shall be visually examined. There shall be no visible damage.

The insulation resistance shall then be measured which shall be not less than the specified value.

After these measurements the units shall be subjected immediately to the cold test.

If this test is included, the relevant specification shall specify the following:

- a) Recovery conditions when deviating from the standard recovery conditions, and
- b) Minimum value of the insulation resistance.

7.5.1.3 Cold — The filters shall be subjected to the test in accordance with 7.1 of IS : 589-1961* at the lower temperature of operating temperature range.

After recovery, the unit shall be visually examined. There shall be no visible damage.

If this test is included, the relevant specification shall specify the duration of the test when deviating from the standard duration.

7.5.1.4 Low air pressure — This test shall be carried out in accordance with 7.12 of IS : 589-1961* using appropriate degree of severity as specified in the relevant specification.

7.5.1.5 Damp heat (accelerated) remaining cycles — The filters shall be subjected to this test in accordance with 7.4 of IS : 589-1961* for the specified number of cycles.

After recovery, the units shall be visually examined. There shall be no visible damage.

The insulation resistance shall then be measured which shall be not less than the specified value.

*Basic climatic and mechanical durability tests for electronic components (revised).

If this test is included, the relevant specification shall specify the following:

- a) Number of cycles,
- b) Recovery conditions when deviating from the standard recovery conditions, and
- c) Minimum value of the insulation resistance.

7.6 Damp Heat (Long Term Exposure) — The filters shall be subjected to this test in accordance with 7.3 of IS : 589-1961* using specified degree of severity.

After recovery, the unit shall be visually examined. There shall be no visible damage.

The insulation resistance, transducer attenuation and phase characteristics at nominal load impedance shall then be measured and shall meet the requirements specified in the relevant specification.

7.7 Rapid Change of Temperature — This test shall be carried out in accordance with 7.14 of IS : 589-1961* using appropriate degree of severity as specified in the relevant specification.

The filters shall then be subjected to the following tests and shall meet the requirements specified:

- a) Insulation resistance, and
- b) Transducer attenuation and phase characteristics at nominal load impedance.

7.8 Storage — Unless otherwise specified, the filters shall be stored for 2 000 hours without operation at the maximum temperature of the rated operating temperature range $\pm 3^{\circ}\text{C}$. At the end of the storage period and before the final measurements are made, the filter is kept at standard atmospheric conditions for testing until thermal equilibrium is attained.

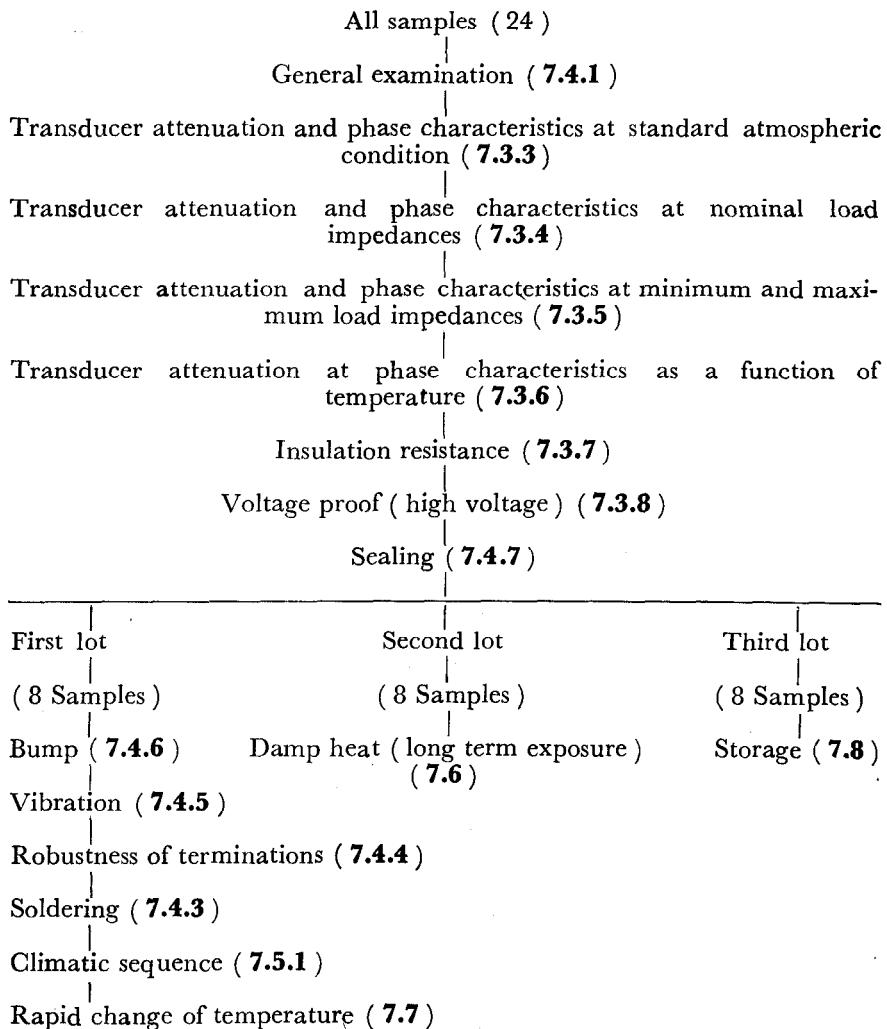
The transducer attenuation and phase characteristics at nominal load impedance shall then be measured and shall meet the requirements specified in the relevant specification.

*Basic climatic and mechanical durability tests for electronic components (revised).

APPENDIX A

(Clause 7.1.1)

SCHEDULE OF TYPE TESTS



INDIAN STANDARDS
ON
Piezo-Electric and Magnetic Materials

IS:

| | | | | | | Rs |
|----------------------|---|-----|-----|-----|-----|------|
| 1176-1969 | Dimensions for aerial rods and slabs made of ferromagnetic materials | ... | ... | ... | ... | 1.50 |
| 1885 (Part V)-1965 | Electrotechnical vocabulary: Part V Quartz crystals | ... | | | | 1.50 |
| 1885 (Part XII)-1966 | Electrotechnical vocabulary: Part XII Ferromagnetic oxide materials | ... | ... | ... | ... | 7.00 |
| 2916 (Part I)-1969 | Quartz crystal units used in oscillators: Part I General requirements and tests | ... | ... | ... | ... | 8.00 |
| 2935-1964 | Guide for use of quartz oscillator crystals | ... | ... | ... | ... | 5.50 |
| 4570-1968 | Crystal holders | ... | ... | ... | ... | 8.50 |
| 5575 (Part I)-1970 | Temperature control devices for quartz crystal units: Part I General requirements and tests | ... | ... | ... | ... | 7.50 |